Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Stratified Flow over Rough Topography BRUCE SUTHERLAND, DAWN AGUILAR, University of Alberta — Linear theory and Long's model for stratified flow over topography both assume free-slip lower boundary conditions and so neglect the possibility of boundary-layer separation either between successive hill crests or in the lee of a range of hills. Here we report upon laboratory experiments that focus upon periodic finite-amplitude hills which are representative of the Earth's major mountain ranges as well as the fractured crevasses of the ocean floor. The topographic shapes are selected to encompass varying degrees of roughness, from smoothly-varying sinusoidal hills to steeper triangular and rectangular hills. For low flow speeds, U (and hence low values of the excitation frequency), the internal wave frequencies are consistent with those predicted by linear theory. However, when the excitation frequency exceeds the buoyancy frequency, N, internal waves are still excited and their frequencies are found to be an approximately constant fraction of N. In all experiments the wave amplitudes are much smaller than predicted because, through boundary-layer separation, fluid is trapped in the valleys between hills effectively reducing the peak-to-peak hill height, H. This is true even if NH/U is moderately less than 1. For rough topographies, turbulent structures emerge even at low towing speeds and waves are generated by the nonlinear interactions between the flow, lee waves and turbulence far in the lee.

Bruce Sutherland
University of Alberta

Date submitted: 11 Aug 2005 Electronic form version 1.4